8. PROJECT DESCRIPTION: DREDGING

This chapter describes the marine dredging requirements specific to the Arrow LNG Plant, including the dredge methods, areas to be dredged, and likely timing of dredging activities. The dredging activities included in the Western Basin Dredging and Disposal (WBDD) Project for Port Curtis are not considered in this chapter, but for context are described briefly below.

8.1 Background

Development of the Port of Gladstone and adjacent Gladstone State Development Area requires improved shipping access within Port Curtis, particularly to facilitate access to the proposed LNG projects. Deepening, widening and extension of existing shipping channels, swing basins and berth pockets are proposed through the WBDD Project. The environmental impacts of the proposed dredging have been assessed through the WBDD Project environmental impact statement (EIS) (GHD, 2009a) and EIS Addendum (GHD, 2010a) prepared for the Gladstone Ports Corporation.

In addition to the dredging performed under the WBDD Project, construction and operation of the Arrow LNG Plant will require dredging to provide (and maintain) shipping access to marine infrastructure sites on Curtis Island and the mainland. Of the five potential dredge sites identified by Arrow Energy, three will be required. The potential dredge sites include access to launch site 1 or 4N, the materials offloading facility (MOF) and the LNG jetty (Figure 8.1).

Arrow Energy's dredging and disposal requirements will, where possible, be integrated with dredging being undertaken as part of the WBDD Project. Dredge spoil disposal options will be discussed with the Gladstone Ports Corporation and relevant government agencies, as Arrow Energy's preference is for disposal of spoil in existing and proposed disposal sites that have been approved.

8.2 Arrow LNG Plant Dredging

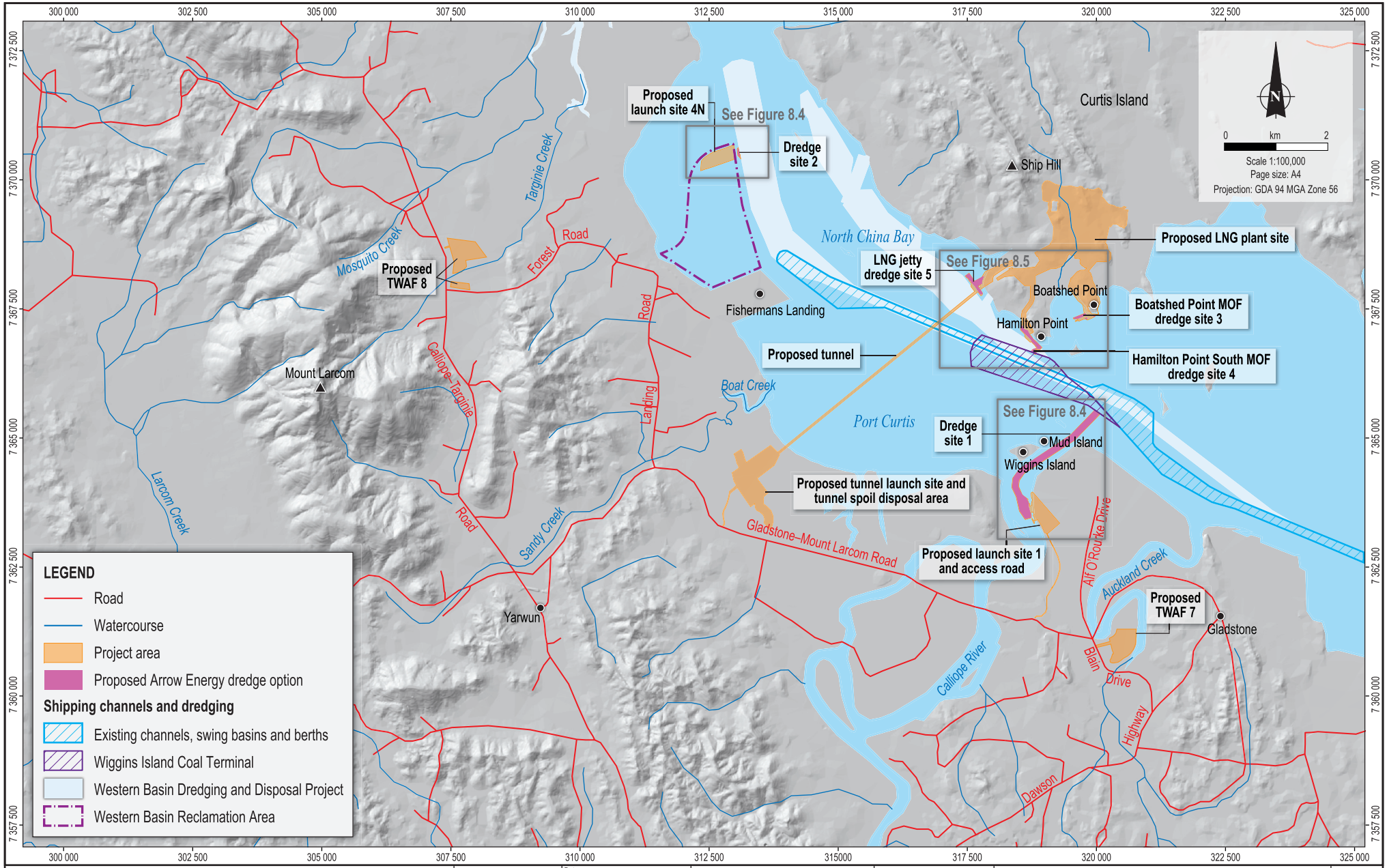
This EIS assesses the additional dredging required for the construction and operation of the project that is not considered under the WBDD Project. Both capital and maintenance dredging will be required. Capital dredging involves the creation of new shipping channels or berths. Maintenance dredging is required to keep open navigable areas that become silted up over time.

Capital dredging to facilitate construction and operation will be required for the following marine facilities:

- Jetties at launch site 1 and launch site 4N on the mainland (two site options) including dredging in the Calliope River to provide access to launch site 1.
- The MOF and passenger jetty on Curtis Island (two site options at Hamilton and Boatshed points).
- The LNG jetty on Curtis Island.

Maintenance dredging may be required for the following areas:

- The Calliope River, including the access channel and LNG jetty areas.
- The MOF and passenger jetty on Curtis Island (minimal dredging expected due to seabed levels and geometry).



Source:
Place names, roads and watercourses from DME.
Project area and digital elevation model from Coffey Environments.
Proposed Arrow Energy dredge options from Arrow Energy.
Western Basin Dredging Master Plan and Disposal Project from Gladstone Ports Corporation.

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Arrow LNG Plant

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Dredge site options

Figure No: 8.1

The preferred option is to place dredged material in the Western Basin Reclamation Area. The dredged material will be treated as required under the conditions of this approval (including for acid sulfate soils if required). The impacts of the placement of dredged material into the reclamation area and the ongoing management of the site are covered in the WBDD EIS (GHD, 2009a; 2010a).

8.3 Dredging Methods

Dredging will most likely be undertaken using backhoe dredgers and cutter suction dredgers. The choice of dredging technique used at a specific location will depend on the size of the area to be dredged, the depth of water and the substrate at that location. Backhoe dredgers are generally more suitable in shallower locations, close to the shoreline, with limited manoeuvring space and dredging close to existing structures. Cutter suction dredgers are able to operate in deeper water and can be used where hard surface materials are present, such as gravel or rock. A cutter suction dredger typically has higher production rates than a backhoe dredger and will require shorter operating periods to dredge similar volumes.

The final choice of dredge method at each location will depend on which site is selected for the MOF and the mainland launch site.

Dredgers are able to operate 24 hours per day, 7 days a week. Crews are typically accommodated on board vessels. The dredge workforce will be between 20 and 40 (including those on tug boats and barges) depending on the dredging method chosen.

The dredging program for the project will be coordinated with dredging activities for the Gladstone Ports Corporation and the other port users and LNG project proponents.

Cutter suction dredging and backhoe dredging methods are described in more detail below.

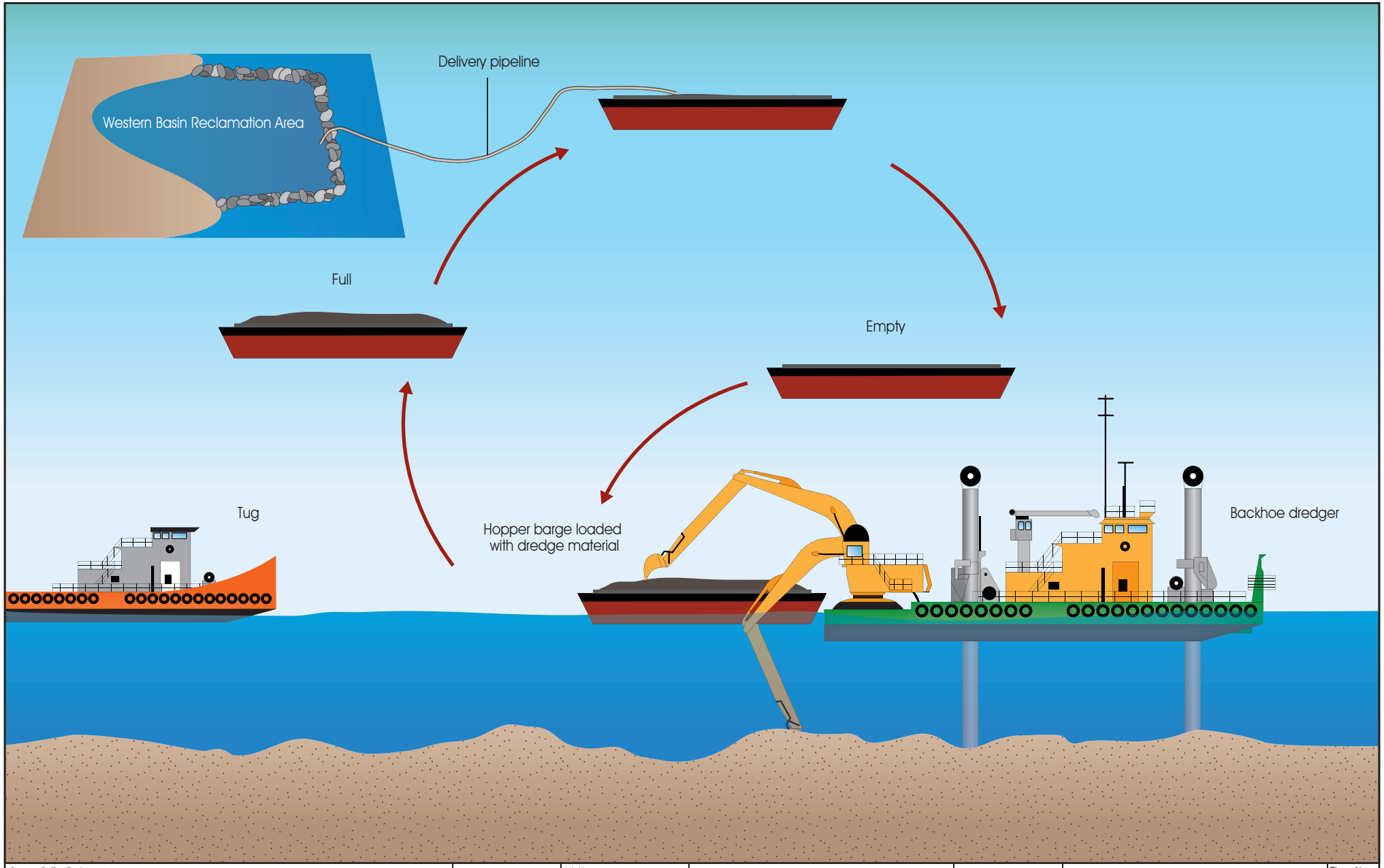
8.3.1 Backhoe Dredger

The backhoe dredger is a hydraulic excavator equipped with a half open shell (bucket). The dredger is stationary, mounted on an anchored barge or jack-up platform. The bucket is filled by moving it along the sea floor towards the machine. The dredged material is transferred to hopper barges (normally moored alongside the backhoe dredger) for transportation to the disposal site (Figure 8.2). Continuous dredging is possible with an appropriate number of barges supporting dredging operations.

Backhoe dredgers are able to excavate a wide range of substrates. Material is excavated using a bucket of size compatible with the in situ strength of the substrate being dredged. Production is dependent upon bucket size, water depths and the hardness of the dredge material. The size and specifications for the backhoe dredgers used on the project will be determined closer to construction.

8.3.2 Cutter Suction Dredger

A cutter suction dredger uses a rotating cutter head to disaggregate the material to be dredged. The rotating cutter – an assembly of cutting teeth on a rotary frame – is mounted at the lower end of a ‘ladder’ used to support the cutter drive and the suction pipe. The rotating action of the cutter dislodges seabed material. The loosened material (and water) enters a suction pipe and is pumped into a delivery pipeline. A suspended sediment plume formation tends to occur, but only at the cutter head.



Source: Coffey Environments	coffey environments	Job No: 7033	Arrow Energy	arrow energy go further	Backhoe dredger operation	Figure No: 8.2
		File Name: 7033_07_F08.02_FT	Arrow LNG Plant			

Cutter suction dredgers operate by swinging about a central working spud. A spud is a large pole that anchors a ship while allowing a rotating movement around the point of anchorage. Anchor wires connect the lower end of the ladder to anchors either side of the ship and allow the dredger to clear an arc of cut by pulling on alternate sides using a system of winches.

The dredger is able to move forward by pushing against the working spud, using a spud carriage. The dredged material is then pumped to hopper barges or directly ashore via a submerged delivery pipeline to designated disposal areas. The pipeline will be laid on the seabed to avoid obstructing other vehicles in the harbour (Figure 8.3).

The size and specifications for the cutter suction dredgers used on the project will not be known until closer to construction. With multiple crews, it is anticipated a cutter suction dredger can work 24 hours day, 7 days week with in situ production rates between 500 m^3 and 750 m^3 per hour.

8.4 Capital Dredging Locations

Three project locations will require dredging; the LNG jetty, MOF and passenger jetty and mainland launch site. There are two options for the location of the MOF and mainland launch site, with two respective dredging requirements for each. The dredging site locations (and options) are described below, and are summarised in Table 8.1.

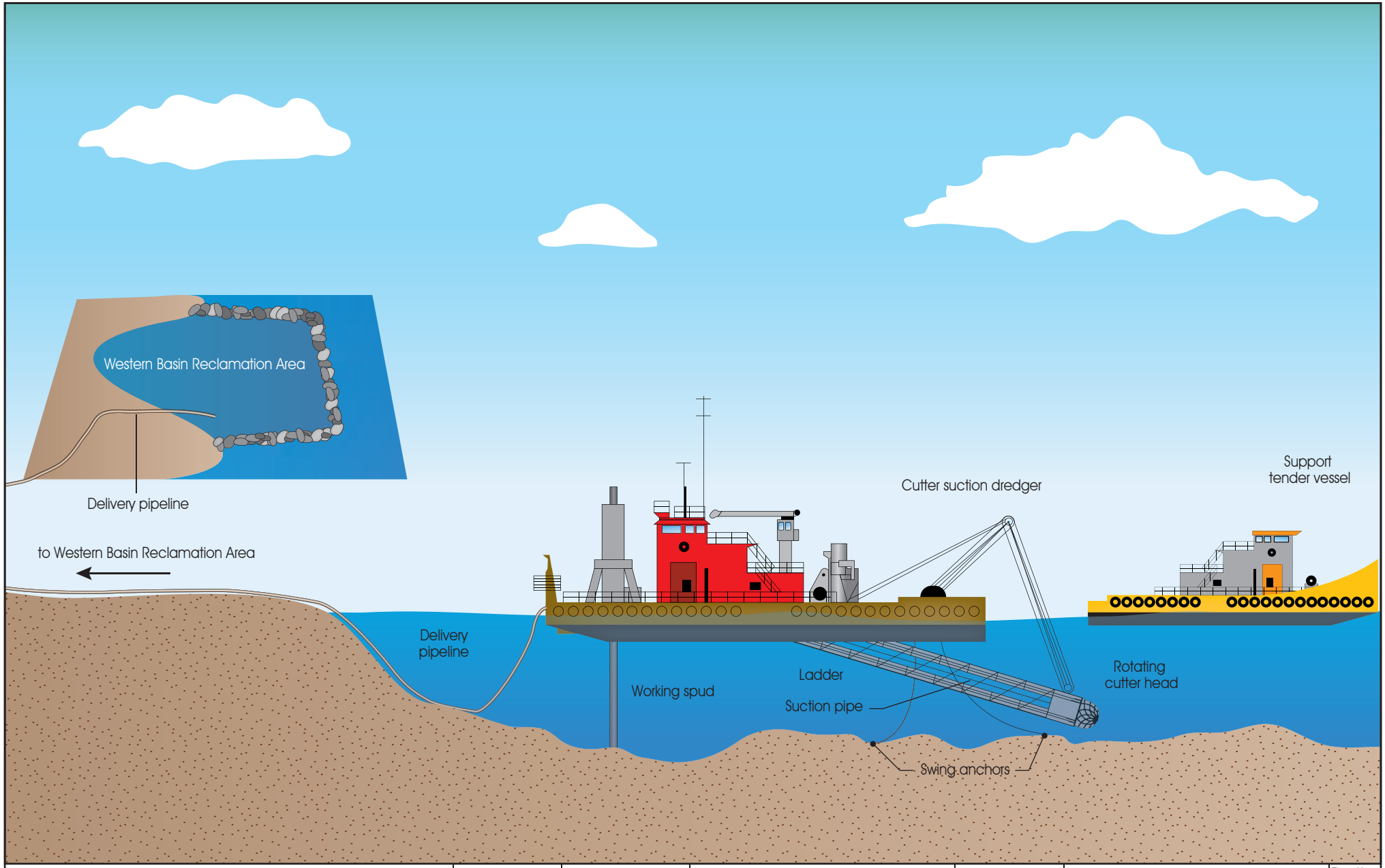
Table 8.1 Summary of dredging requirements for the Arrow LNG Plant

Site No.	Marine Infrastructure	Likely Dredging Method	Design Dredged Level (m LAT)	Estimated Maximum Dredge Volume (m^3)	Indicative Timing
1	Launch site 1 Calliope River	Cutter suction or backhoe	-4.5	900,000	Late 2014
2	Launch site 4N Fisherman's Landing (option)	Cutter suction or backhoe	-5	2,500	Late 2014
3	Boatshed Point MOF and passenger jetty	Backhoe	-2.5 to -8	50,000	Late 2014
4	Hamilton Point South MOF and passenger jetty (option)	Cutter suction or backhoe	-8	50,000	Late 2014
5	LNG jetty	Cutter suction or backhoe	-2.5	120,000	Late 2014

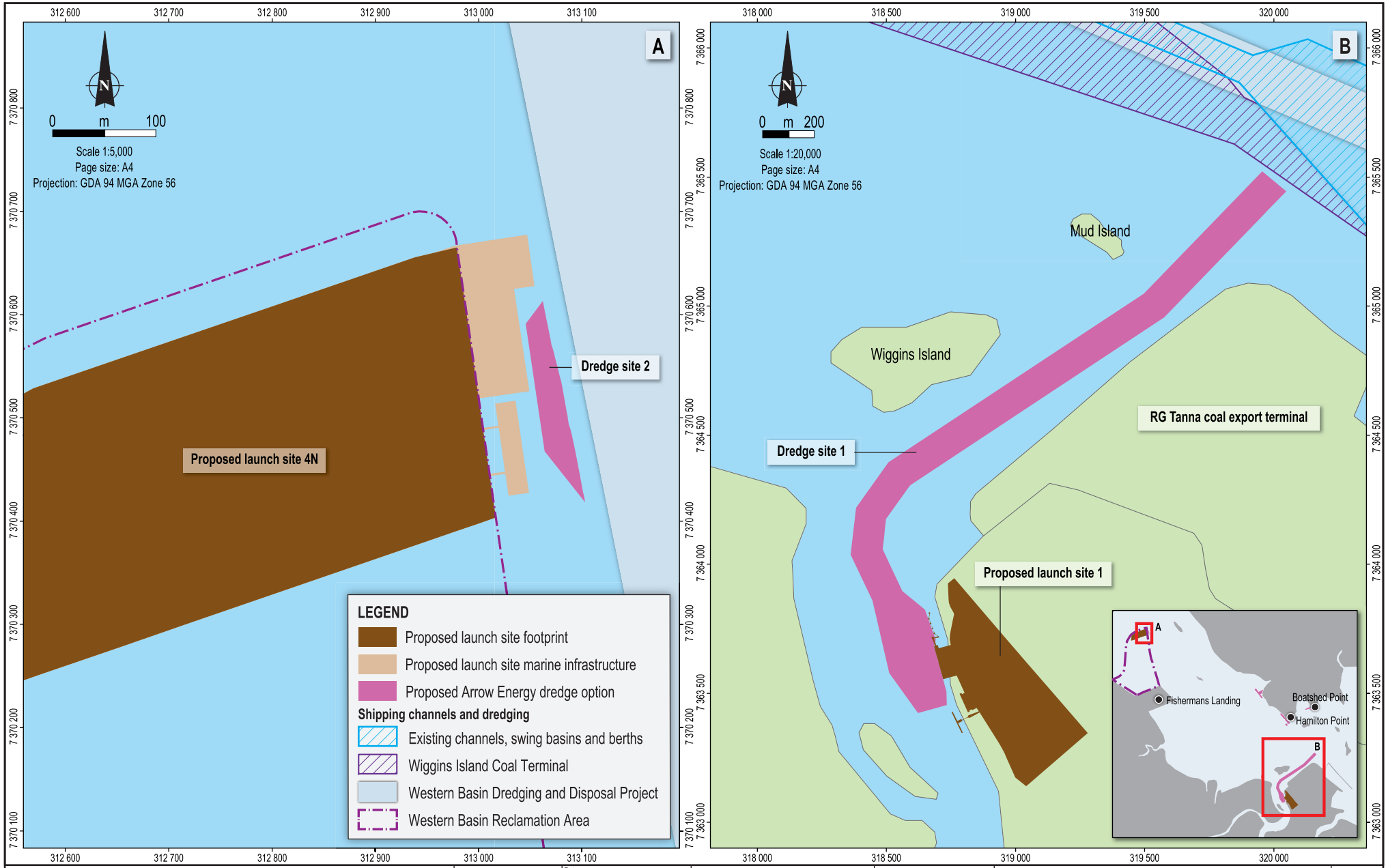
8.4.1 Mainland Launch Site

The mainland launch site will contain a passenger terminal and a jetty. Two options are being considered for the mainland launch site. Both sites require dredging and are described below:

- **Dredge site 1 and launch site 1.** Dredging will be required for the construction and operation of launch site 1 located north of Gladstone city near the mouth of the Calliope River, adjacent to the existing RG Tanna coal export terminal. The dredge site will extend from the intertidal area abutting launch site 1, past Mud Island to the main shipping channel (Figure 8.4), providing adequate under-keel depth for vessel docking and navigation. The access channel will be approximately 2.8 km long by 120 m wide and dredged to -4.5 m LAT.



Source: Coffey Environments	coffey environments	Job No: 7033	Arrow Energy	arrow energy go further	Cutter suction dredger operation	Figure No: 8.3
		File Name: 7033_07_F08.03_FT	Arrow LNG Plant			



Source:
Place names from DME.
Proposed dredge options, ancillary facilities and marine infrastructure from Arrow Energy.
Western Basin Dredging Master Plan and Disposal Project from Gladstone Ports Corporation.

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Dredge sites 1 and 2

Figure No: 8.4

The maximum dredge volume estimated at this site is approximately 900,000 m^3.

A cutter suction dredger is most likely to be used at this site. Excavated material will be pumped either via submerged temporary delivery lines (or booster stations) or via temporary overland delivery pipeline and transported to the Western Basin Reclamation Area. Dredging at launch site 1 is estimated to take between three and four weeks of effective dredging.

- **Dredge site 2 and launch site 4N (option).** Dredging will be required for the construction and operation of launch site 4N located at the northern extent of the Western Basin Reclamation Area. This dredge site would abut launch site 4N and extend east from the launch site to the shipping channel to provide adequate depth for vessel docking and navigation (see Figure 8.4). The area will be dredged to a depth of -5 m LAT.

  The maximum dredge volume identified at this site is approximately 2,500 m^3. Dredge slopes at this site are assumed to be 1:3 m LAT.

  A backhoe dredger will most likely be used at this site. Excavated material will be transferred to shuttle barges and transported to the Western Basin Reclamation Area. Dredging at launch site 4N is estimated to be short in duration (e.g., less than one week of effective dredging).

8.4.2 Materials Offloading Facility and Passenger Jetty

The two options being considered for the MOF and passenger jetty will require dredging and are described below:

- **Dredge site 3 and Boatshed Point MOF.** Dredging will be required for the construction and operation of the personnel jetty and MOF on the southern tip of Boatshed Point. Roll-on, roll-off and lift-on, lift-off facilities will be constructed adjacent to a personnel jetty to allow berthing by high-speed catamarans and vehicle or passenger ferries.

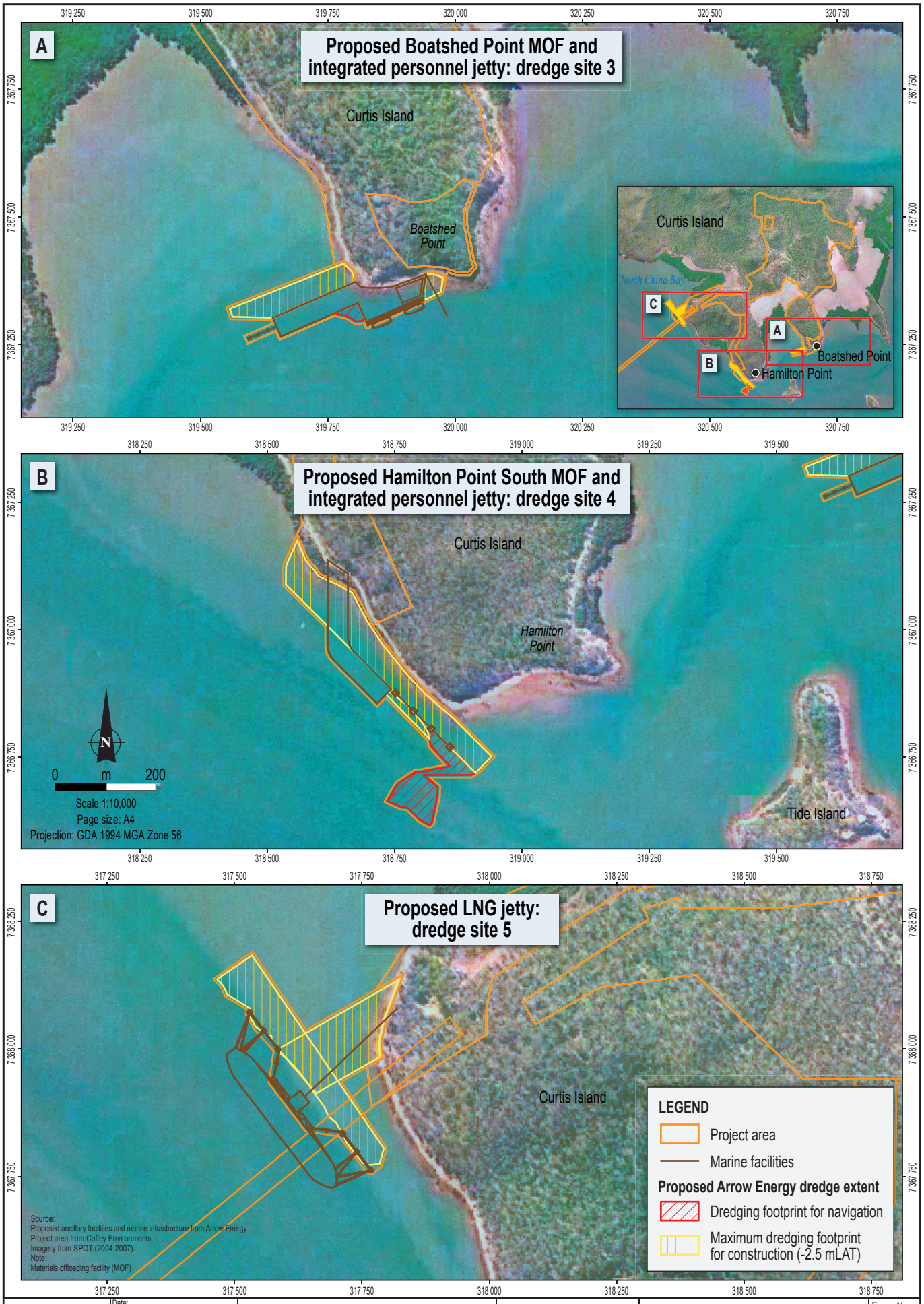
  The dredge area around these facilities will provide adequate depth for vessel docking and navigation (Figure 8.5). The area will be dredged to a depth of -8 m LAT to accommodate roll-on, roll-off and lift-on, lift-off vessels using the MOF, -5 m LAT for barges and passenger ferry berths, and -2.5 m LAT for high-speed catamarans and vehicle or passenger ferries using the personnel jetty berth.

  The estimated maximum dredge volume identified at this site is approximately 50,000 m^3.

  A backhoe dredger is most likely to be used at this site. Excavated material will be loaded onto barges and transported to the Western Basin Reclamation Area. Dredging at Boatshed Point is estimated to take between one and two weeks of effective dredging.

- **Dredge site 4 and Hamilton Point South MOF (option).** Dredging is required for the construction and operation of the MOF on the southern tip of Hamilton Point, Curtis Island. Roll-on, roll-off and lift-on, lift-off facilities will be constructed at the site.

  Dredging will provide adequate depth for docking and navigation at this location (see Figure 8.5). The area between the MOF facilities and the shipping channel will be dredged to a depth of -2.5 m LAT to accommodate floating construction equipment, and to -8 m LAT in a smaller area to accommodate roll-on, roll-off and lift-on, lift-off vessels. The maximum dredge volume identified is approximately 50,000 m^3. Dredging required to maintain navigable depths associated with this location is addressed in the WBDD EIS (GHD, 2009a).



coffey environments	Date: 16.11.2011 MXT: 7033CA_07_GIS110_v1_4 File Name: 7033_07_F08.05_GIS_FT	Arrow Energy Arrow LNG Plant	arrow energy go further	Dredge sites 3, 4 and 5	Figure No: 8.5

A cutter suction dredger is likely to be used at this site. Excavated material will be loaded onto barges and transported to the Western Basin Reclamation Area. Dredging at Hamilton Point South is estimated to take between one and two weeks of effective dredging.

8.4.3 LNG Jetty

Additional dredging, beyond the scope under the WBDD Project, may be required for the construction of the LNG jetty on Curtis Island in North China Bay, adjacent to the northwest corner of Hamilton Point. Dredging will provide access to floating construction equipment required to assemble the LNG jetty. Capital dredging of the berth pocket and swing basin is addressed in the WBDD EIS and is not discussed further.

The LNG jetty will be constructed from a barge. Dredging may be required to allow the barge to work in this area. This dredge site extends towards the coast, parallel to the landward edge of the berth pocket, and over an area toward the shoreline (see Figure 8.5). The area will be dredged to a depth of -2.5 m LAT.

The maximum dredge volume identified at this site is approximately 120,000 m^3.

A backhoe dredger is most likely to be used at this site (although a small cutter suction dredger may be used if feasible). Excavated material from the backhoe dredger will be loaded onto barges and transported to the Western Basin Reclamation Area. Dredging of the LNG jetty area is estimated to take between two and three weeks of effective dredging.

8.5 Maintenance Dredging

The capital dredging works described above are required for the construction and operation of the marine infrastructure for the project. Some maintenance dredging may be required to remove fine sediment siltation in the Port Curtis navigation channels, the Arrow LNG Plant swing basin and berth pockets for the marine infrastructure.

Modelling has shown that maintenance dredging may be required in the Calliope River channel to maintain access to the mainland launch site 1 (see Chapter 16, Marine Water Quality and Sediment). Any maintenance dredging required in the Calliope River will be managed by Arrow Energy.

8.6 Disposal of Dredged Material

Arrow Energy has investigated a range of options for disposal of dredge spoil, with the preference being disposal in the approved Western Basin Reclamation Area (see Chapter 5, Assessment of Alternatives). The following additional options have been identified by Arrow Energy as feasible for disposal of dredge spoil:

- East Banks Sea Disposal Site – as approved by Commonwealth Government.
- New offshore disposal site – as approved by Commonwealth Government.
- New onshore reclamation area.